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Ho et al.

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(54) **VIRTUAL IMAGE DISPLAY SYSTEM AND POINTING DIRECTION CONTROL METHOD OF CONTROL DEVICE THEREOF**

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Related U.S. Application Data

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(51) **Int. Cl.**

(57) **ABSTRACT**

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G06T 19/00 (2011.01)

G06F 3/0346 (2013.01)

G02B 27/01 (2006.01)

A virtual image display system and a pointing direction control method of a control device thereof are proposed. The pointing direction control method of the control device includes causing the control device to display an index pattern having a recognition pointing direction, causing a virtual image display device to capture the index pattern displayed by the control device, and causing the virtual image display device to analyze the recognition pointing direction of the index pattern and to display a control cursor according to the recognition pointing direction.

(52) **U.S. Cl.**

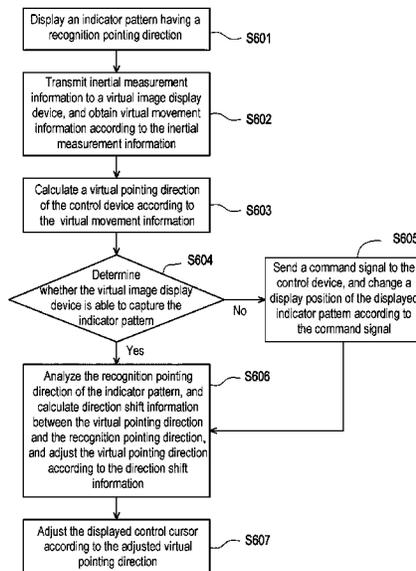
CPC **G06F 3/0383** (2013.01); **G06F 3/0346** (2013.01); **G06T 19/006** (2013.01); **G02B 27/0172** (2013.01); **G02B 2027/014** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

10 Claims, 5 Drawing Sheets



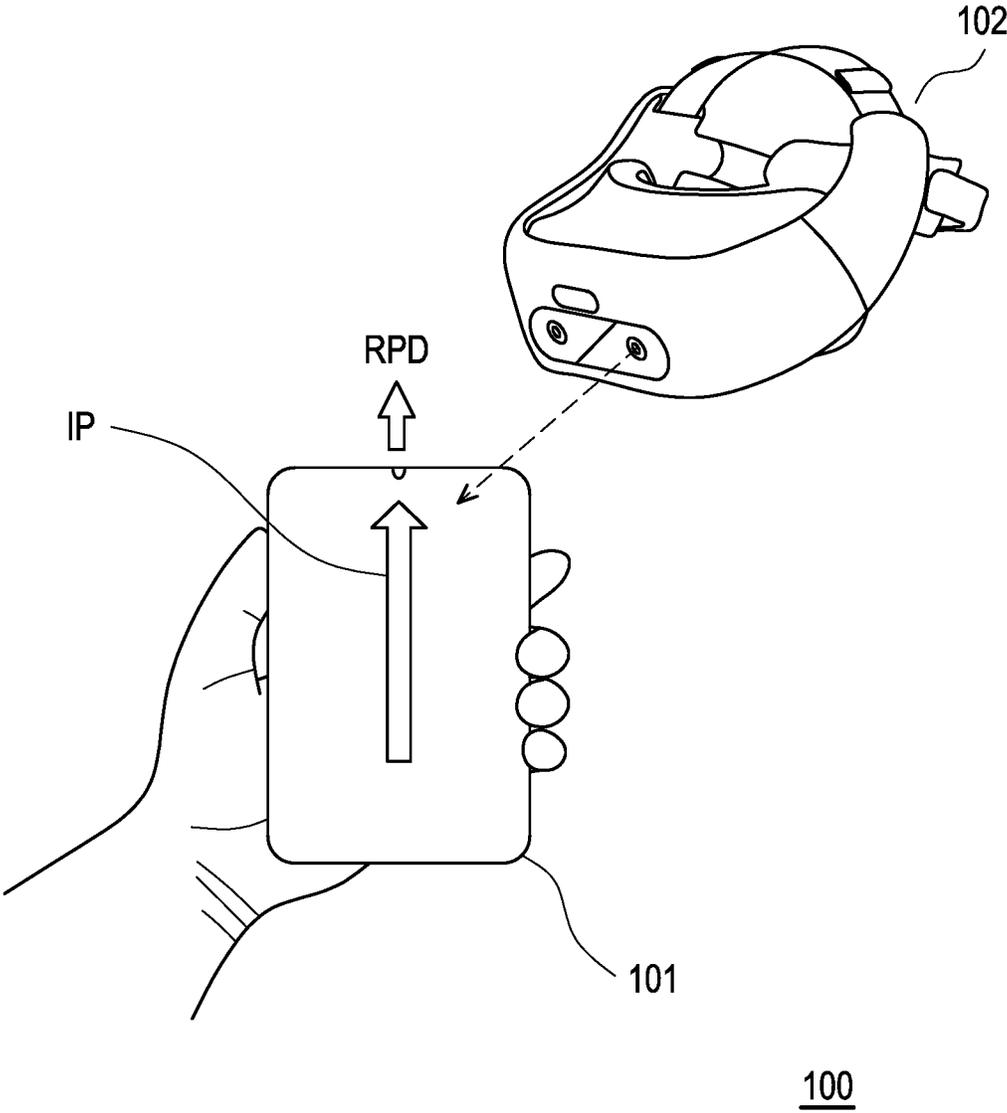


FIG. 1

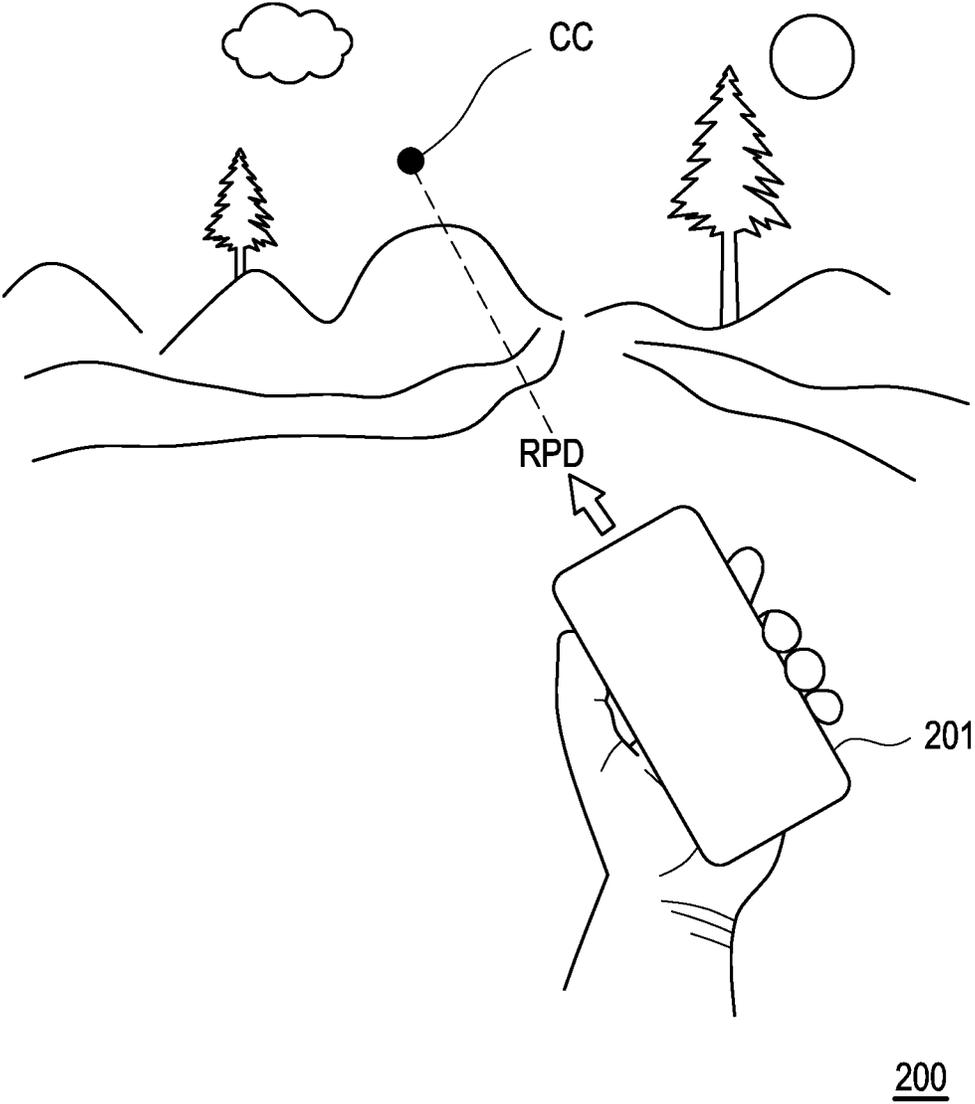


FIG. 2

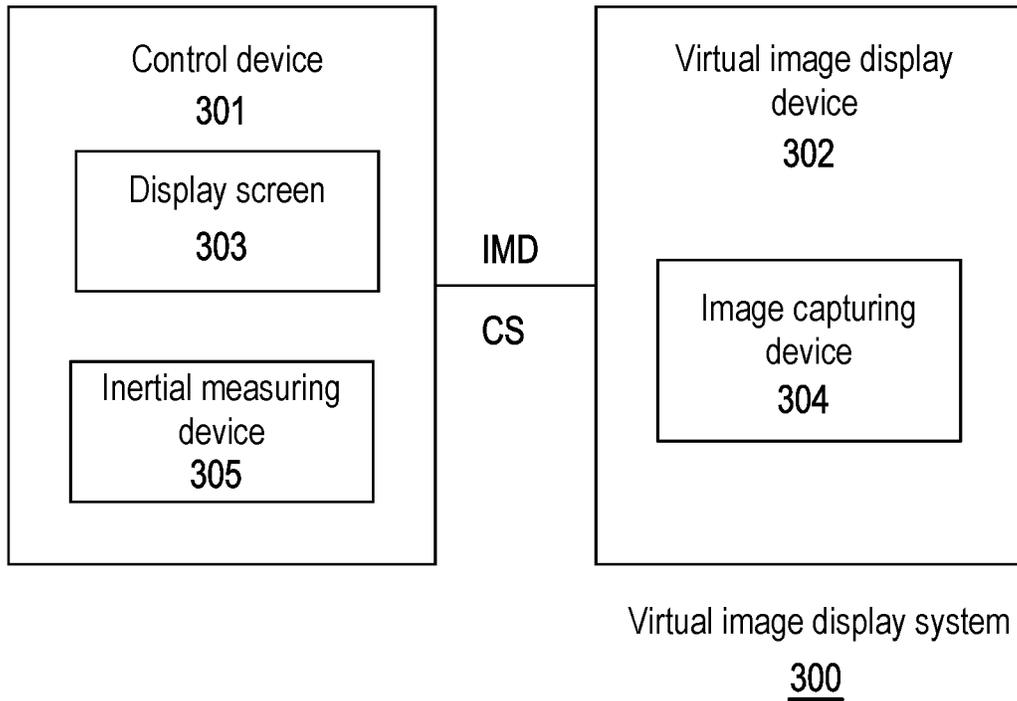


FIG. 3

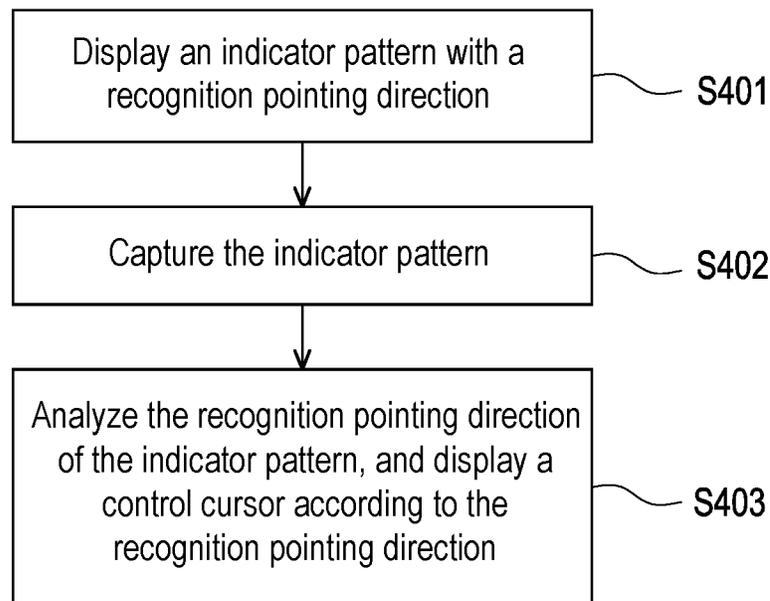
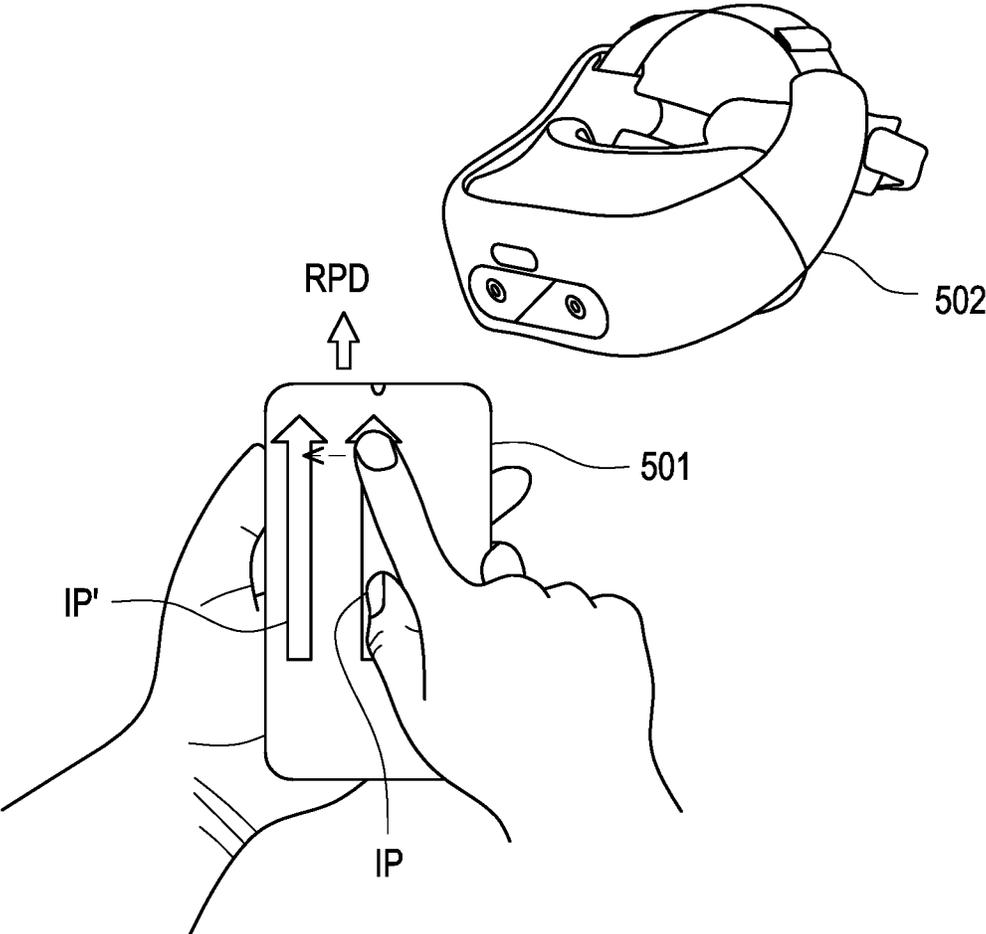


FIG. 4



500

FIG. 5

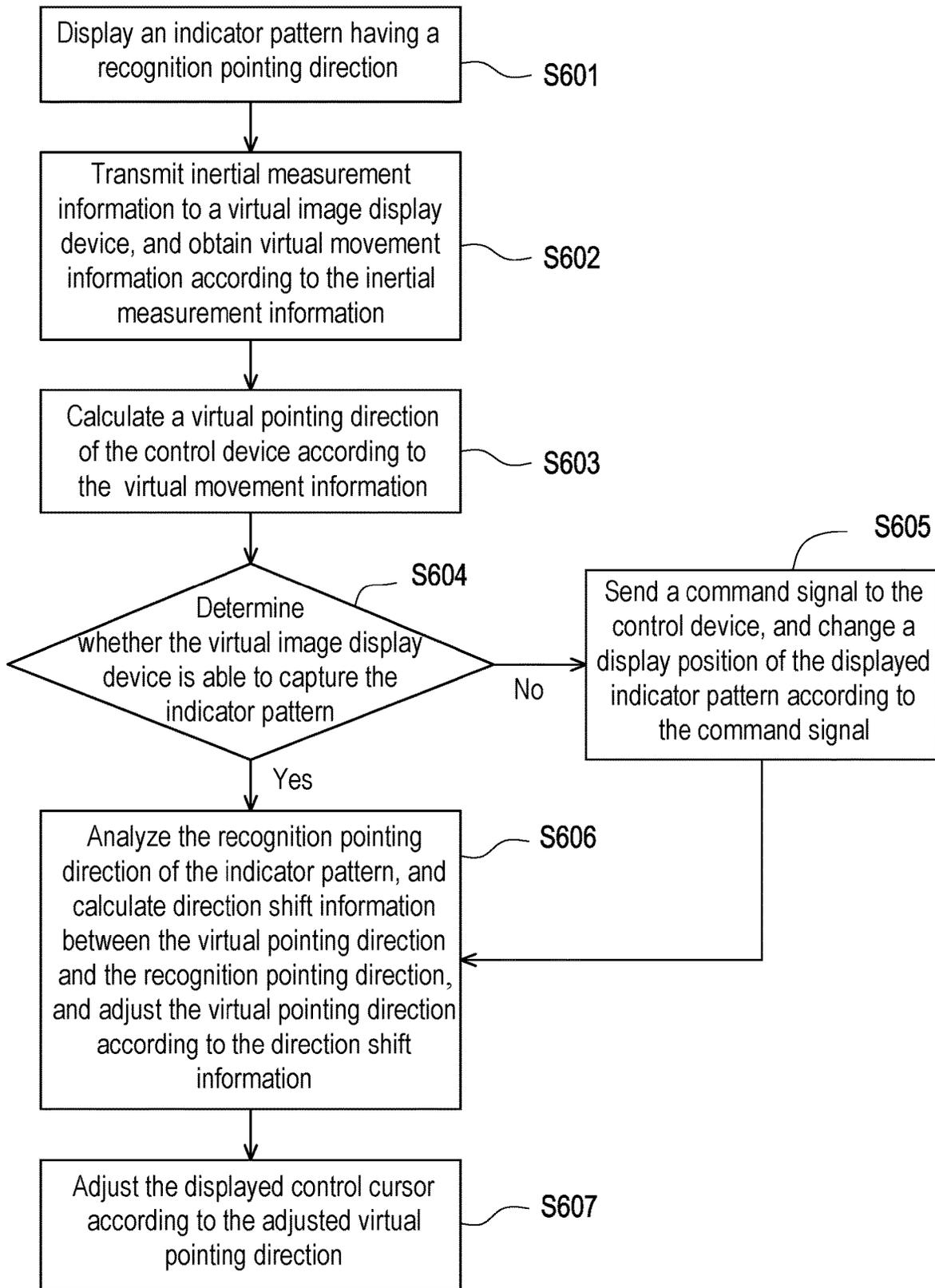


FIG. 6

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VIRTUAL IMAGE DISPLAY SYSTEM AND POINTING DIRECTION CONTROL METHOD OF CONTROL DEVICE THEREOF

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the priority benefit of U.S. provisional application Ser. No. 63/274,943, filed on Nov. 3, 2021. The entirety of the above-mentioned patent application is hereby incorporated by reference herein and made a part of this specification.

BACKGROUND

Technical Field

The disclosure relates to a virtual image display system and a control method, particularly relates to a virtual image display system and a pointing direction control method of a control device thereof.

Description of Related Art

In the conventional virtual image display system, a cursor in a virtual image display frame may be controlled by a handheld control device. The handheld control device transmits the sensed inertial measurement information to a virtual image display device, such that the virtual image display device may estimate the position of the handheld control device according to the sensed inertial measurement information and control the pointing direction of the displayed cursor.

A way for the handheld control device to sense the inertial measurement information is by using the inertial measurement unit (IMU) to measure the displacement amount to control the cursor movement in the virtual image display frame according to the measured displacement amount of the handheld control device. However, the displacement amount measured by the existing IMU often accumulates error over time. When the error is accumulated to a certain extent, it becomes perceivable by a user, causing the user to suffer from error in the control operation of the existing virtual image display system and have poor user experience.

SUMMARY

The disclosure is directed to a pointing direction control method of a control device and a virtual image display system, which are adapted to reduce an error between a control cursor and a pointing direction of the control device.

The disclosure provides a pointing direction control method of a control device including: displaying an indicator pattern with a recognition pointing direction by the control device; capturing the indicator pattern displayed by the control device by a virtual image display device; and analyzing the recognition pointing direction of the indicator pattern by the virtual image display device and displaying a control cursor according to the recognition pointing direction.

The disclosure provides a virtual image display system including a control device and a virtual image display device. The control device is configured to display an indicator pattern with a recognition pointing direction. The virtual image display device is coupled to the control device. The virtual image display device is configured to capture the indicator pattern displayed by the control device, analyze the

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recognition pointing direction of the indicator pattern, and display a control cursor according to the recognition pointing direction.

Based on the above description, the virtual image display device of the disclosure may set a pointing direction of a control cursor displayed in a virtual image by recognizing the recognition pointing direction of the indicator pattern displayed by the control device. Therefore, the virtual image display device of the disclosure is adapted to reduce an error between the control cursor and the pointing direction of the control device, and effectively improve the user's sense of experience in virtual image experience.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of a virtual image display system according to an embodiment of the disclosure.

FIG. 2 is a schematic diagram of a virtual image frame according to an embodiment of the disclosure.

FIG. 3 is a hardware block diagram of a virtual image display system according to an embodiment of the disclosure.

FIG. 4 is a flowchart of a pointing direction control method of a control device according to an embodiment of the disclosure.

FIG. 5 is a schematic diagram of a virtual image display system according to another embodiment of the disclosure.

FIG. 6 is a flowchart of a pointing direction control method of a control device according to another embodiment of the disclosure.

DESCRIPTION OF THE EMBODIMENTS

Referring to FIG. 1, FIG. 1 is a schematic diagram of a virtual image display system according to an embodiment of the disclosure. A virtual image display system 100 includes a control device 101 and a virtual image display device 102, where the virtual image display device 102 is coupled to the control device 101. The control device 101 is configured to display an indicator pattern IP, where the indicator pattern IP has a recognition pointing direction RPD. The control device 101 may be any handheld electronic device with a display function, such as a smart phone, a tablet computer, or a smart watch. In the embodiment of FIG. 1, the indicator pattern IP may be a pattern in the form of an arrow and point to the recognition pointing direction RPD. It should be noted that, in other embodiments, the indicator pattern IP may be a pattern of any shape that may be recognized to recognize the recognition pointing direction RPD.

The virtual image display device 102 is configured to capture the indicator pattern IP displayed by the control device 101, and the virtual image display device 102 is further configured to analyze the indicator pattern IP to obtain the recognition pointing direction RPD. Furthermore, the virtual image display device 102 displays a control cursor CC according to the recognition pointing direction RPD.

Referring to FIG. 1 and FIG. 2, FIG. 2 is a schematic diagram of a virtual image frame according to an embodiment of the disclosure. The virtual image display device 102 may be used to display a virtual image frame 200. The virtual image frame 200 includes a display frame of virtual reality and the control cursor CC. The virtual image display device 102 may generate the control cursor CC in the display frame of virtual reality according to an extended projection of the recognition pointing direction PRD. In some embodiments, the virtual image frame 200 may further include a

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virtual control device frame **201**. A position of the virtual control device frame **201** may correspond to a position of the indicator pattern IP displayed by the control device **101** in reality, and the virtual control device frame **201** is directed toward the recognition pointing direction PRD.

In the embodiment, it should be noted that the virtual image display device **102** obtains the recognition pointing direction RPD by analyzing the indicator pattern IP of the control device **101**, rather than obtaining the pointing direction only according to an outline of the control device **101**. In this way, the control device **101** may be different handheld electronic devices manufactured by various manufacturers, and may have different sizes and shapes. In addition, the recognition pointing direction RPD has more directional information relative to the outline of the control device **101**.

Referring to FIG. 3, FIG. 3 is a hardware block diagram of a virtual image display system according to an embodiment of the disclosure. A virtual image display system **300** in FIG. 3 includes a control device **301** and a virtual image display device **302**, and the virtual image display device **302** may be coupled to the control device **301** in a wired or wireless manner. The control device **301** has a display screen **303** for displaying the indicator pattern IP. The virtual image display device **302** has an image capturing device **304** for capturing the indicator pattern IP displayed on the display screen **303** of the control device **301**. In the embodiment, the image capturing device **304** is, for example, a camera or a video camera, which may be used to capture static or dynamic images. Any communication protocol well-known to those skilled in the art may be used for information transmission between the control device **301** and the virtual image display device **302**. In addition, the control device **301** further includes an inertial measuring device **305**. The inertial measuring device **305** is used to measure the inertial measurement information IMD. Furthermore, the control device **301** transmits the inertial measurement information IMD to the virtual image display device **302**. In other embodiments, the virtual image display device **302** may transmit a command signal CS to the control device **301** to control the display of the indicator pattern IP of the control device **301**.

Referring to FIG. 4, FIG. 4 is a flowchart of a pointing direction control method of a control device according to an embodiment of the disclosure. In step S401, the control device **101** displays the indicator pattern IP having the recognition pointing direction RPD. In step S402, the virtual image display device **102** captures the indicator pattern IP displayed by the control device **101**. In step S403, the virtual image display device **102** analyzes the recognition pointing direction RPD of the indicator pattern IP. The virtual image display device **102** displays the control cursor CC according to the recognition pointing direction RPD.

According to the above virtual image display system of FIG. 1 and the pointing direction control method of the control device of FIG. 4, the virtual image display system and the control method of the disclosure may control the cursor according to the recognition pointing direction of the control device, and avoid poor control experience caused by errors accumulated by the inertial measuring device, which may be adapted to outline shapes of various control devices (handheld electronic devices), and may provide directional information to control the cursor according to the recognition pointing direction.

Referring to FIG. 5, FIG. 5 is a schematic diagram of a virtual image display system according to another embodiment of the disclosure. A virtual image display system **500** includes a control device **501** and a virtual image display

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device **502**. Basic operations of the virtual image display system **500** are similar to that of the virtual image display system **100** of FIG. 1, and details thereof are not repeated. Different from FIG. 1, in the embodiment, when the virtual image display device **502** captures the indicator pattern IP, if the virtual image display device **502** cannot effectively capture the indicator pattern IP, it means that the indicator pattern IP in the display screen of the control device **501** may be shielded at this moment. The virtual image display device **502** may send a command signal CS to the control device **501**. Correspondingly, the control device **501** may adjust a display position of the indicator pattern IP according to the command signal CS.

In FIG. 5, the indicator pattern IP is shielded by user's finger. At this moment, the virtual image display device **502** may send the command signal CS to the control device **501**, and the control device **501** may adjust an original display position of the indicator pattern IP to display a new indicator pattern IP'. In this way, the virtual image display device **502** may successfully capture the new indicator pattern IP'. It should be noted that the indicator pattern IP and the indicator pattern IP' have the same pointing direction.

Referring to FIG. 6 and FIG. 3, FIG. 6 is a flowchart of a pointing direction control method of a control device according to another embodiment of the disclosure. In step S601, the control device **301** may display the indicator pattern IP having the recognition pointing direction RPD on the display screen **303**. In step S602, the control device **301** transmits the inertial measurement information IMD to the virtual image display device **302**, and the virtual image display device **302** obtains virtual movement information according to the inertial measurement information IMD. The inertial measurement information IMD may be measured and generated by the inertial measuring device **305** in the control device **301**. The virtual image display device **302** may calculate the virtual movement information of the control device **301** according to the inertial measurement information IMD.

In step S603, the virtual image display device **302** calculates a virtual pointing direction of the control device **301** according to the above-mentioned virtual movement information. It should be noted that since the virtual pointing direction is calculated according to the inertial measurement information IMD, there may be an error between the virtual pointing direction and the actual pointing direction of the control device **301** as time is accumulated.

In step S604, the virtual image display device **302** determines whether the indicator pattern IP may be captured. If the determination result is yes, then step S606 is performed; and if the determination result is negative, it means that the indicator pattern IP is probably shielded, and step S605 is performed. In step S605, the virtual image display device **302** sends the command signal CS to the control device **301**, and the control device **301** changes a display position of the displayed indicator pattern IP according to the command signal CS.

In step S606, the virtual image display device **302** may analyze the recognition pointing direction RPD of the indicator pattern IP, and calculate direction shift information between the virtual pointing direction and the recognition pointing direction RPD; and the virtual image display device **302** adjusts the virtual pointing direction according to the direction shift information. In step S606, since the virtual image display device **302** may obtain an actual pointing direction of the control device **301** through the recognition pointing direction RPD, the error between the virtual point-

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ing direction and the actual pointing direction of the control device 301 may be effectively reduced.

In step S607, the virtual image display device 302 may adjust the displayed control cursor CC according to the adjusted virtual pointing direction, and may generate the control cursor CC in consistence with the actual pointing direction of the control device 301.

In summary, the pointing direction control method of the control device and the virtual image display system of the disclosure may adjust the position of the control cursor by recognizing the recognition pointing direction of the indicator pattern displayed by the control device, which may reduce the display error of the control cursor and achieve good control experience.

What is claimed is:

1. A pointing direction control method of a control device, comprising:

displaying an indicator pattern by the control device, wherein the indicator pattern has a recognition pointing direction;

capturing the indicator pattern displayed by the control device by a virtual image display device;

analyzing the recognition pointing direction of the indicator pattern by the virtual image display device to determine a control cursor, and displaying the control cursor according to the recognition pointing direction;

sending a command signal to the control device by the virtual image display device when the indicator pattern is displayed by the control device and the indicator pattern is unable to be captured by the virtual image display device; and

changing a display position of the displayed indicator pattern by the control device according to the command signal.

2. The pointing direction control method of the control device as claimed in claim 1, further comprising:

transmitting inertial measurement information to the virtual image display device by the control device; and obtaining virtual movement information of the control device by the virtual image display device according to the inertial measurement information.

3. The pointing direction control method of the control device as claimed in claim 2, further comprising:

calculating a virtual pointing direction of the control device by the virtual image display device according to the virtual movement information.

4. The pointing direction control method of the control device as claimed in claim 3, further comprising:

calculating direction shift information between the virtual pointing direction and the analyzed recognition pointing direction by the virtual image display device; and

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adjusting the virtual pointing direction by the virtual image display device according to the direction shift information.

5. The pointing direction control method of the control device as claimed in claim 4, wherein displaying the control cursor according to the recognition pointing direction comprises:

adjusting the displayed control cursor according to the adjusted virtual pointing direction.

6. A virtual image display system, comprising:

a control device, configured to display an indicator pattern, wherein the indicator pattern has a recognition pointing direction; and

a virtual image display device, coupled to the control device, and configured to:

capture the indicator pattern displayed by the control device; and

analyze the recognition pointing direction of the indicator pattern to determine a control cursor, and display the control cursor according to the recognition pointing direction;

wherein when the indicator pattern is displayed by the control device and the virtual image display device is unable to capture the indicator pattern, the virtual image display device sends a command signal to the control device, and the control device changes a display position of the displayed indicator pattern according to the command signal.

7. The virtual image display system as claimed in claim 6, wherein the control device comprises an inertial measuring device, the inertial measuring device transmits inertial measurement information to the virtual image display device, and the virtual image display device obtains virtual movement information of the control device according to the inertial measurement information.

8. The virtual image display system as claimed in claim 7, wherein the virtual image display device calculates a virtual pointing direction of the control device according to the virtual movement information.

9. The virtual image display system as claimed in claim 8, wherein the virtual image display device calculates direction shift information between the virtual pointing direction and the analyzed recognition pointing direction, and the virtual image display device adjusts the virtual pointing direction according to the direction shift information.

10. The virtual image display system as claimed in claim 9, wherein the virtual image display device adjusts the displayed control cursor according to the adjusted virtual pointing direction.

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